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DEVELOPMENT OF A SCADA SYSTEM FOR TEMPERATURE CONTROL USING LAB VIEW

BHARGAV N. PATEL, JIGNESH B. PATEL & RAJESH L. ZADFIYA

Department of Instrumentation and Control Engineering, Nirma Institute of Technology, Ahmedabad, Gujarat, India

ABSTRACT

Remote monitoring and control of industrial processes is the need of today's automation industry. SCADA (Supervisory Control and Data Acquisition) system is useful in monitoring, controlling and accessing the performance of remotely situated systems by acquiring and controlling the physical parameters such as temperature, pressure, level etc. This paper describes the design and development of a Lab VIEW based SCADA for temperature control system. Data communication is achieved using the popular Modbus Protocol. Various features like database, data logging, secured login, waveform graphs, trends, history and multi-user functionality are also incorporated. The developed SCADA system will be an independent and indigenous tool since Lab VIEW supports the generation of executable file which can practically run on any computer without having Lab VIEW software package.

KEYWORDS: SCADA, Lab VIEW, RTU, HMI (Human Machin Interface), Controller

INTRODUCTION

Supervisory Control and Data Acquisition (SCADA) is a technology that enables a user to collect data from one or more distant facilities and send control instructions to those facilities. Today SCADA implementations have evolved from custom or proprietary hardware and software to standard commercially available hardware and software platforms. The features of SCADA have led to reduction of cost in development, operation and maintenance as well as providing executive management with real-time information that can be used to support planning, supervision, and decision making in complex environments. These benefits, however, come with a cost. A well-developed SCADA system saves time and money by eliminating the need for service personnel to visit each site for inspection, data logging or make necessary tuning and adjustments.

This paper presents the work carried out in implementing a Lab VIEW based SCADA for Temperature control system. Mod bus protocol supports a master-slave communication strategy. Data communication between RTU (Remote terminal unit) & Master Device in Modbus is achieved by assigning a unique slave ID to each remote device. Once the master/slave relationship is established, the direction of control is always from the master to the slave [1][2]. This enables acquiring and controlling of the physical parameters such as temperature in real time environment. Lab VIEW package comes with a rich Graphical programming toolkit.

COMPONENTS AND OPERATIONAL BLOCK DIAGRAM

The process of developing the overall system can be perceived in three stages,

- Temperature Control Loop

- Lab VIEW Programming
- SCADA

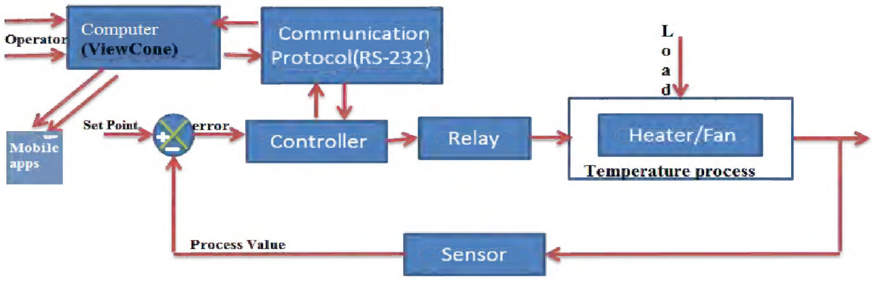


Figure 1: Basic Block Diagram of System

Temperature Control Loop

Temperature control loop consists of Thermocouple, Relay, Heater or Fan and PID controller which is shown in figure 1. Control of the process is achieved by means of a closed loop circuit; power fed to the heater is regulated according to feedback signal obtained via the thermocouple. This process loop is modeled as a mimic in the developed Lab VIEW based SCADA software and the respective components of the complete loop can communicate with the personal computer through USB interface [3].

LABVIEW Programming

Lab VIEW is virtual instrument software. Lab VIEW contains comprehensive set of tools for acquiring, analyzing, controlling, displaying and storing data. We use Lab VIEW with data logging and supervisory control module (DSC module), visa tool, database connection tool kit, report generation tool kit in Lab VIEW to create SCADA applications for the process industry.

SCADA

SCADA system can be divided into two parts hardware and software.

SCADA Hardware

A SCADA system consists of number of remote terminal units (RTUs) collecting field data and sending that data back to a master station, via a communication system. The master station displays the acquired status of the plant operation and process.

First step in establishing the communication is to choose a baud rate and protocol compatible to the host computer or the master. Communication on a MODBUS protocol is initiated by a master issuing a query to a slave [4][5][6]. The slave which is constantly scanning the network for queries will recognize only the queries addressed to it and will respond either by performing an action or by returning a response. Only the master can initiate a query.

SCADA Software

SCADA software can be of two types, proprietary or open. Different companies have developed proprietary software to communicate to their field devices, but in an industry where the projects are executed by several vendors, proprietary SCADA software's limit the smooth integration of the complete system. Hence Open software systems have gained popularity because of the interoperability and smooth integration they bring to the overall system. Schneider's Cytec

and Invensys Wonder Ware are just two of the open software packages available in the market for SCADA systems. Some packages are now including asset management Integrated within the SCADA system. However, the key features of a typical SCADA system are:

- Human machine interface (HMI)
- Alarm handling
- Data logging
- Event and log monitoring
- Data processing applications
- Report generator
- Spreadsheet
- Charting and trending [7].

SOFTWARE DEVELOPMENT

The software programming and implementation of logic of the system has been designed in Lab VIEW. The controlling of the remote process is through Lab VIEW Programming via port interfacing. The system has been programmed in such a way that no human intervention at the process site is necessary once the system has been initiated. As the system is started, controller starts receiving the feedback signal, it will take corrective action and sends an ON or OFF signal back to the process such as heater and fan to start and stop. Lab VIEW receives the Data of controller and the HMI contains the START/STOP buttons, the status indicators, and GUI of the system.

The current value of temperature, read through the instrument driver, is displayed. Depending on these conditions, the outputs are switched. Example, if the temperature falls below a set value, then the heating coil is switched on. The system being monitored is a PID controlled system [8] [9] [10]. The front panel or the HMI of the system is as shown in figure 2. This indicates the logical programming in Lab VIEW software's back panel.

Figure 2 displays the main page or HMI of the system, which consists of temperature control loop, and SCADA features like graph, history, data logging and alarm acknowledgement button. It also has facility to display the continuously varying graph of temperature value and controller output. The system can be asynchronously halted by the STOP button in the front panel during emergency conditions

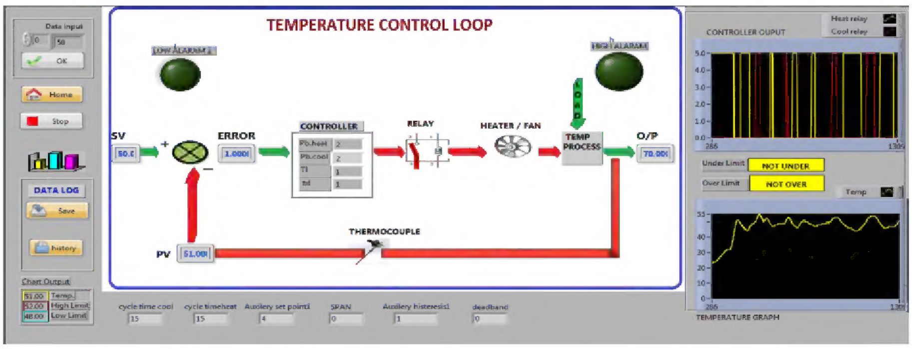


Figure 2: Front Panel of the Graphical User Interface of Temperature Control System

- **Graph:** For graphical view of the process parameters, 'Graph' button is provided in the HMI of the system in LabVIEW, which shows the continuously varying real-time graph of temperature and controller output with respect to time.

- **Measurement of Historical Data**: 'Data logging' button is available on the HMI of the system. Pressing data logging button process parameter values start storing in the database. On pressing the 'History button' it will open a new window exclusively for the historical data as shown in figure 3, where we can see 'search data' and 'time control' features. These features can provide data between the particular time periods entered by the user [11].

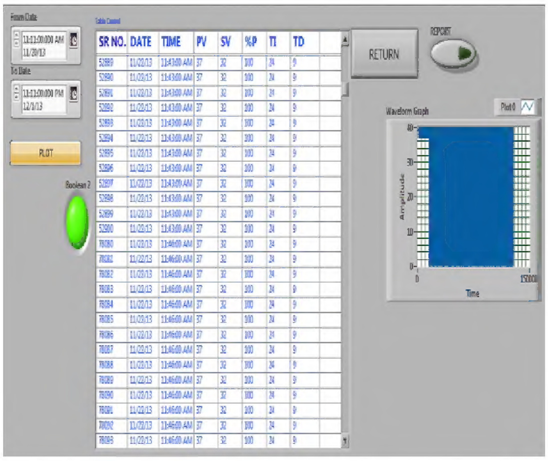
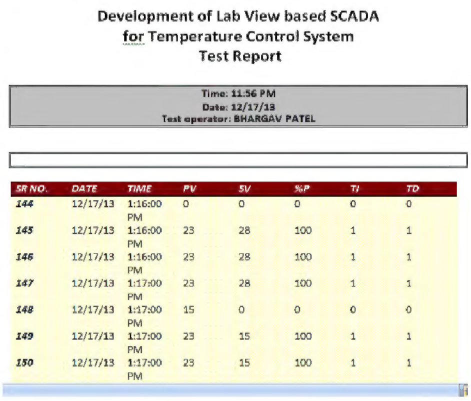


Figure 3: Front Panel of the Historical Data



Development of Lab View based SCADA
for Temperature Control System
Test Report

Time: 11:56 PM
Date: 12/17/13
Test operator: BHARGAV PATEL

SR NO.	DATE	TIME	PV	SV	%P	TI	TD
144	12/17/13	1:16:00 PM	0	0	0	0	0
145	12/17/13	1:16:00 PM	23	28	100	1	1
146	12/17/13	1:16:00 PM	23	28	100	1	1
147	12/17/13	1:17:00 PM	23	28	100	1	1
148	12/17/13	1:17:00 PM	15	0	0	0	0
149	12/17/13	1:17:00 PM	23	15	100	1	1
150	12/17/13	1:17:00 PM	23	15	100	1	1

Figure 4: Front Panel of Report Generation

- **Report Generation:** It generates the report of the data for the user specified time periods as described in search database section. It also has the facility to show the graph of the particular data. User can also generate the data in hard copy from the file generated. Figure 4 shows the front panel of report generation.

- **Alarm Handling**: An alarm typically denotes an abnormal condition, which occurs under certain specific conditions, or must be acknowledged by the user or configured for automatic acknowledgment. Abnormal condition is visualized in the HMI

CONCLUSIONS

Lab VIEW works steadily with the hardware and the program is function well with no major error occurred. A mimic of the process is developed in Lab VIEW and various features of the general SCADA system such as user

interface, graphical displays, alarms, trends, database management, report generation, data logging, charting and historian, real-time monitoring and controlling are effectively developed and implemented.

Lab VIEW supports the generation of .exe file which can practically run on any computer without having to install the relatively expensive Lab VIEW software package. Devloped Lab VIEW based SCADA provides management with real-time data on temperature operations which will help to an implement more efficient control paradigms, improves plant and personnel safety, and reduces costs of operation.

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